International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

Potential uses of Waste Sludge in Brick Manufacturing: A Review

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Abstract: *Waste generation and management is becoming a worldwide challenge resulting into increased environmental concern. Waste management and recycle into a sustainable construction materials as proved to be an alternate for waste disposal helping call at the world environmental pollution and economic. In recent years various sort of waste has been used/reused within the development of sustainable construction materials. This study reviews various attempts that are made to use sludge from different plants in housing industry. The mechanical and physical properties of the products, the environmental effect of the products and possible recommendations for future research was presented in this review.*

KeyWords: *Brick, Compressive Strength, Sludge, and Water Absorption, etc…*

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1. Introduction

Due to rapid growth of industrialization and technology it is our prime duty to save our nature. The increase in demand for construction materials in recent years as a result of development has involved alternative due to develop construction material from other sources. Brick is a popular building material all over the world because of its economical cost, superior finish as well as high compressive strength and durability. Demand for bricks is ever increasing which is resulting in escalation of cost, particularly in India. Brick manufacturing is also causing depletion of top fertile clay layer which is used for manufacture of bricks. These problems of cost escalation and depletion of fertile top soil layer can be minimized by substituting the soil with available waste material. It will result in resource saving also solves the disposal problem of waste material. The potential waste material facing disposal problem is water treatment plant sludge. The waste residue that accumulates in sewage and water treatment plants is called sludge. A large quantity of sludge is generated every year from different water treatment plant and sewage treatment plant, which causes difficulties for municipality to dispose the sludge. Treatment plant produce large quantities of by-products commonly known as sludge as a result of treatment process of raw water such as coagulation, flocculation and filtration. The problem of sludge disposal is a major problem owing to environmental concerns, limited resources and few landfills. This study focuses on the likelihood of using sludge as a brick material.

2. Literature review.

Prashantgupta (2015) developed bricks using water treatment plant sludge and clay raw materials was collected and then mixed with clay about 5% of the total weight, water was then added to the mixture in appropriate amount so that mixture would be workable, after burning process would gain sufficient strength various test carried out on burnt bricks. The study reveals that waste from water treatment plant can be used as a substitute of raw material used for brick manufacturing. The addition of water treatment plant sludge (5% by usage) will increase the compressive strength of bricks compare to normal bricks.

Prof K.T. Phalak et al. (2017) developed bricks using dry sludge, soil and fly ash (10%) to increase compressive strength of the bricks and to reduce the water absorption capacity of bricks methodology continuous,

1. Preparation of raw materials

2. Moulding

3. Setting

4. Glazing, firing and burning (about 900’ c)

5. Cooling

6. Testing and results

Following tests are carried out on bricks before moulding on dry sludge,

1. Sieve analysis of dry sludge

2. Dry sludge specific gravity

3. Dry sludge liquid limit

4. Procter compaction test

After burning of bricks compression and water absorption tests are carried out it shows that dry sludge available in free of cost. It reduces the cost of bricks, dry sludge have similar properties compare to the ordinary soil. Study shows that water absorption capacity of the bricks increases by increase in the percentage of dry sludge (10%, 20%, 30%, 40% and 50%) compressive strength decreases with replacement of dry sludge

material reduces the weight of bricks it's become light weight product.

AnyakoraNkovka Victoria (2013) developed a brick using sludge (coagulant sludge) collected from the clarifier of the treatment plant and clay, sieve analysis test carried out in a sieve about 4.76mm diameter sieve were collected and used for manufacturing purpose and retained materials are poured away. To investigate the different effects of recycle sludge on the properties of clay sludge bricks five groups of mixture adopted (0%, 5%, 15%, and 20% by weight of natural clay) moulding of bricks was done in $70mm \times 70mm \times 70mm$ bricks was dried for a period of 7 days at average temperature of 23°c and 76% relative humidity. bricks were burnt in five different temperature of 850°C, 900°C, 950°C, 1000°C and 1050°C for 6 hours fired are slowly cooled in the furnace tests are carried out (compressive strength, water absorption, shrinkage density) tests results shows that the major chemical composition of the sludge was silica, aluminium, and iron oxide which was similar to the major chemical composition of the brick clay, the results shows that with the scanning electron microscope(5tm) image which revealed that the microstructure of sludge composed of flaks of fine clay particles. The results of this work has demonstrated that bricks can be produce using water treatment plant sludge as a supplement for clay under the condition of firing temperature, it shows that water treatment plant sludge can be used to produce good quality bricks for various engineering applications in constructions and building within the acceptable (NIS 74:1976) and international (BS 3921, 1985) standards. This study showed that WTP sludge could be used as brick material for improved workability and physical appearance for economic and environmental sustainability.

Atteman and Berman (1984) investigated the potential use of sludge developed a bricks using mixture of sludge either clay or shale called as bio brick. The bio bricks had the look, smell and feel of regular bricks. Study reveals that conventional shale and clay could be partially supplemented with waste water sludge has solid content 15-20% to produce bricks.

Yagu et al. (2002) developed bricks using dry pulverized sludge in production of bricks by adding 2% of pulverized sludge into the prepared samples can produce prefabricated bricks, properties of specimens was tested. Study shows that significant increase in compressive strength decrease in porosity and water absorption compare to bricks without sludge.

Tay et al. 92002) investigated the potential effect of dried waste water sludge and clay samples with varied sludge percentage was produced and burnt in kiln, study results on the mechanical and physical properties reveals that dry sludge can be used with natural clay at percentage of 0-40 of the total brick weight. Dried sludge contain organic content it burnt off during firing due to the burning of organic content compressive strength with increase in sludge content uneven texture surface and porosity arises, this problem was solved by introducing or replacing dry sludge which as zero organic content and it was determined that the maximum sludge percentage that can be used is 50% and results shows that the bricks containing pulverized sludge had a higher strength than bricks containing sewage sludge. Study shows that brick containing 10% of sludge have strength as high as normal clay bricks.

Badar et al. (2012) manufactured a clay brick by replacing sludge, agricultural and industrial waste (such as rise rusk ash and silica fume) at a different temperature brick samples were burnt. The properties of the product were investigated and compare with conventional bricks in accordance with Egyptian structural specifications. Results showed that products with 25% silica fume and 50% sludge showed superiority over the conventional bricks.

Shreekirthi A Mahajan (2017) manufactured a brick using chemical sludge, ordinary Portland cement, stone dust, fly ash, lime and water. Bricks are manufactured at specified proportions of different kind of materials for achieving good strength with adding appropriate water wet homogeneous mixture is done and finally the mortar is allowed to making brick sample. Tests were carried out (compression, water absorption, efflorescence and soundness test) the properties of the sludge bricks are compared after the testing. Results reveals that automobile effected treatment plant sludge can be a specified partial substitute for brick, the strength of a bricks decreased with increase in sludge concentration water absorption results also indicated that sludge have less water absorption, the bricks with sludge did not have any effect of efflorescence.

Keerthana et.al (2019): manufactured bricks by partial replacement of clay with sludge (10, 20, 30, 40 percentage). In this paper an attempt is made to reduce pollution by producing ecofriendly bricks. The results obtained showed a crushing strength in range of 3.33 N/mm2 to 3. 77 N/mm2.

3. CONCLUSIONS

1. Brick can be successfully produced from water treatment plant sludge incorporated with clay minerals; which contain high silica content; under the conditions, mixing proportions, firing temperatures, and manufacturing methods used in this study.
2. The water treatment plant sludge almost resembled the brick clay in its chemical composition.
3. The physical properties of sludge brick can be enhanced by the addition of clay, but the maximum percentage of water treatment plant sludge, which

can be used in the mixture is dominated by the practiced firing temperature.

4. Incineration of water treatment plant sludge is needed before using in brick manufacturing to evaporate the major part of its relatively high organic content, which indicated by its high loss on ignition (L.O.I) value.

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